Space Weather Technical Forecast

Issued on Saturday, 06 November 2021 at 12:23 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of M-class flares. Chance of isolated G1/Minor geomagnetic storms on days 1 and 2. Active electron fluence likely by days 3 and 4.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: There are currently three numbered regions on the visible disc. AR2891 (Bxo/Beta) in the northwest is small and simple with a continues reduction in overall areal extent. AR2893 (Hsx/Alpha) near centre disk remains a single moderately sized unipolar spot. AR2894 (Cso/Beta) has grown in areal extent as it transits into the southeast quarter, with a small trailer spot evident. A further active region is just beginning to show it's leading edge at the northeast horizon, though remains spotless at present. This may become a source of increased flare activity as it rotates further into view. Two small C-Class and several B-Class flares were evident in the last 24 hours, mostly from AR2894 near the southeast limb.

No Earth-directed CMEs have been seen in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR and ACE at L1, reduced from 600 km/s to 520 km/s by 05/2230 UTC, then rose to 630 km/s by 06/0130 UTC likely due to a glancing blow from a weak CME that left the Sun on the 2nd Nov. Solar winds have since erratically declined back to around 540 km/s. Density was mostly below average initially until 05/2315 UTC when it rose to a maximum density of 38ppcc and has weakened but remained above average since. Total IMF, Bt, was mostly weak, but with an increase to Moderate between 05/2330-06/0030 UTC with a maximum of 10nT. The north-south component, Bz, was mostly weak, fluctuating between +6/-3nT, but with a period of Moderately positive between 05/2330-06/0010 UTC with a maximum of +10nT. Phi angle was mostly positive (away from the Sun), with an switch to mainly negative (toward the Sun) from 05/2245 UTC. Unsettled geomagnetic levels dominated through the period with two Active intervals, one at the start of the period and one after midnight UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16, has returned to background levels. The high energy electron flux (greater than 2 MeV) was at mostly moderate levels in the past 24 hours, with some brief peaks above the high threshold around the diurnal maximum, peak 1.82e3 at 05/1625UTC. The associated 24-hour electron fluence was below the Active (1e8 integrated pfu) threshold and is currently on a flat trend, with 4.49e7 integrated pfu recorded at 06/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to remain mainly Low through the next four days, but with a continuing slight chance of M-class flares.

Solar Wind / Geomagnetic Activity: Solar wind speeds are expected to continue Elevated for the remainder of day 1, but with a possible connection to CH17/+ late on day 1 or day 2 (6th or 7th), possibly increasing solar wind speeds back up to Strong, around 600 km/s. Generally Unsettled geomagnetic activity is expected through much of the period, but perhaps with an increased chance of Active to G1/Minor Storm intervals from late day 1 into day 2 (6th/7th).

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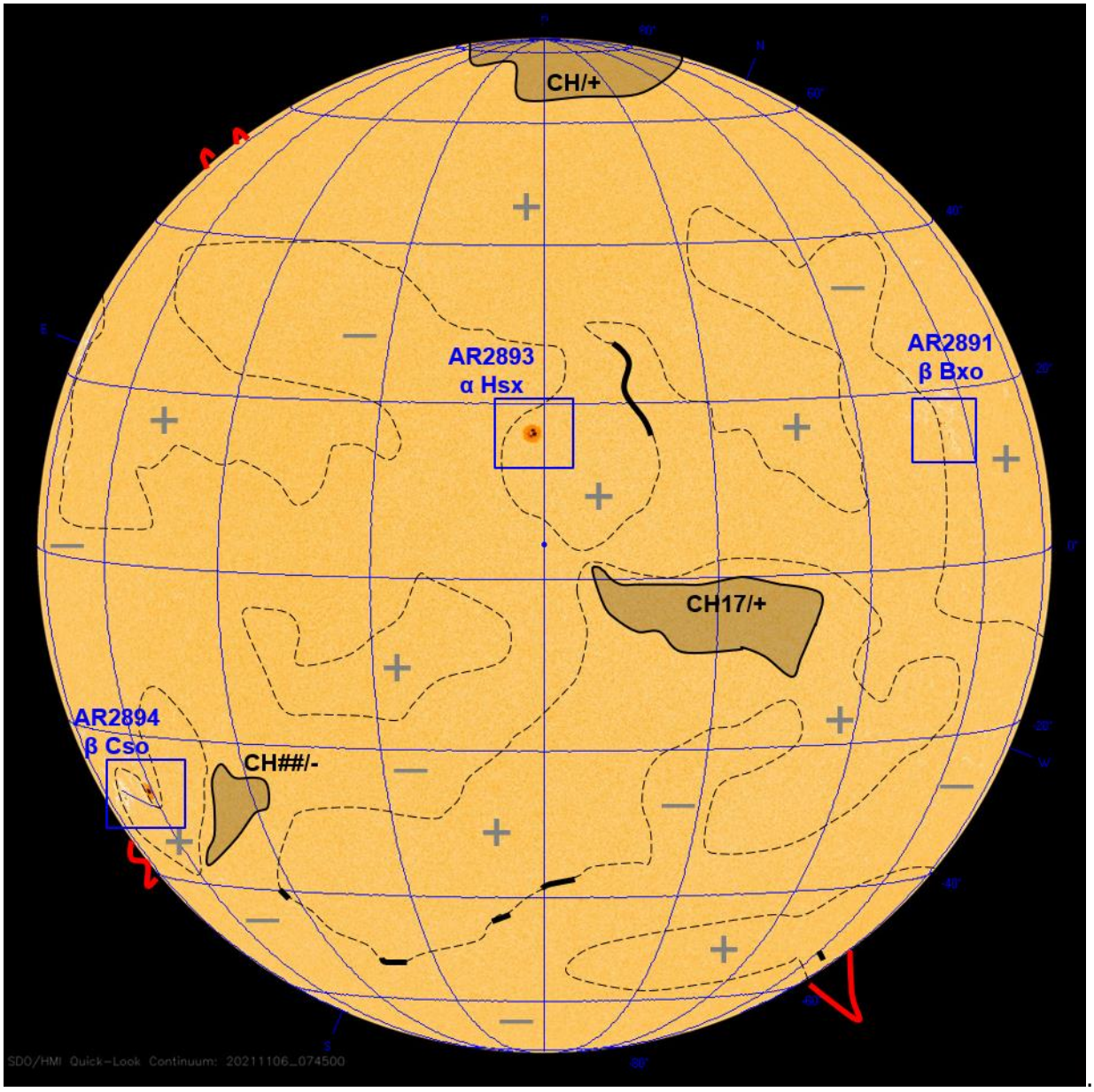
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain below the S1 minor storm level close to background levels. The high energy electron flux (greater than 2 MeV) is likely to reach high levels at times through the next 4 days, especially on diurnal peaks. Corresponding 24 hour electron fluence values are currently below the Active (1e8 integrated pfu) threshold, but an overall increasing trend is likely through the period. The Active threshold is likely to be breached between days 2 to 4 but there is only low confidence for the timing of this.

Figure 1. Solar Analysis Valid 06/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar winds responded to the passage of a small glancing CME from 2nd November during the early hours of 6th Nov. No other Earth directed CMEs have been observed or are expected to be en-route at present.

Coronal hole (CH17/+) is located around 36 degrees west of centre disc, and just south of the solar equator. This feature looks a little different to last rotation (it's further advanced this time around) and last time it was superseded by the arrival of a CME, meaning any forecast is low confidence. However, the most likely arrival time on this rotation is later on day 1 (6th) or on day 2 (7th), with a wind speed of 550-600 km/s possible. STEREO-A appears to show signs of HSS influence around this time. However, wind speeds at Earth may still be raised above background levels from waning CME effects, so the HSS could effectively prolong the elevated wind speeds.

Quiet to Unsettled geomagnetic activity is expected through much of the period, but perhaps with an increased chance of Active to G1/Minor Storm intervals on days 1 and 2 (6th and 7th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	40	20	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Real Time Solar wind trace.

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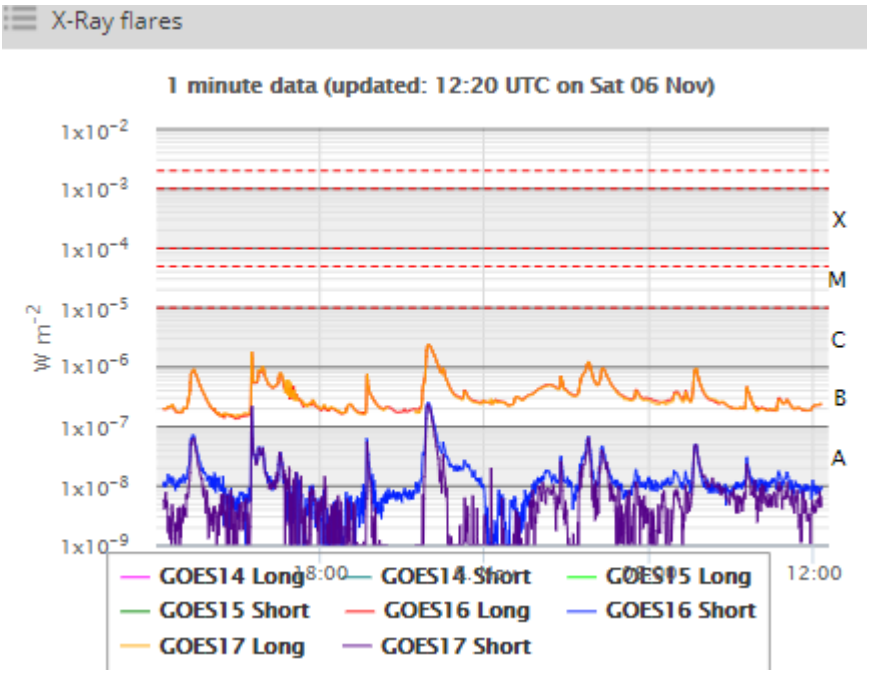
Radio Blackouts - X-Ray Flares:

There are currently three numbered regions on the visible disc. AR2891 and AR2894 (Hsx/Alpha) continue to be simple with little overall flare activity. AR2893 (Cso/Beta) remains the most complex and active with two C-Class flares originating from this region in the past 24 hours. A further potential active region is just beginning to show it's leading edge at the northeast horizon, and is showing an increase in flare potential but remains spotless at present.

Solar Activity from the numbered regions on the visible disc is expected to be at Low levels, with a slight chance of isolated M-class flares, now most likely from AR2893. Probabilities have been slightly increased from day 2 (7th) in anticipation of a possible new region rotating around the northeast limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	15	15	15
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: 24 hour Xray trace, GOES.



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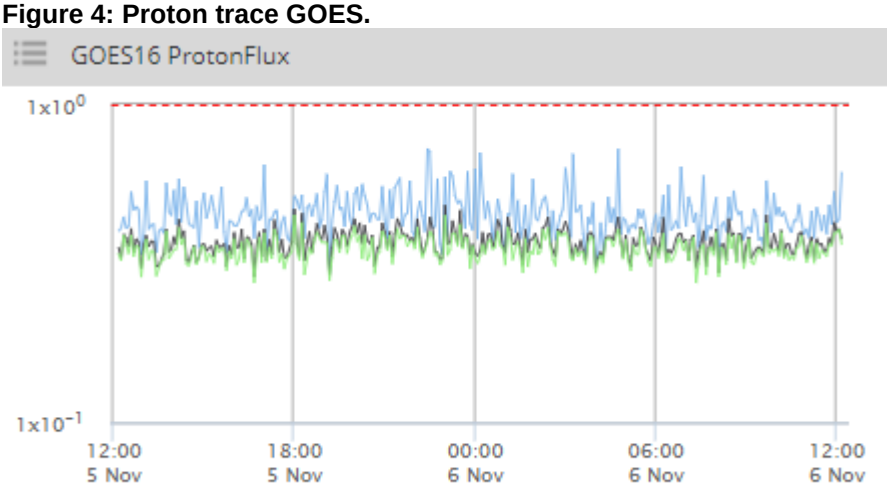
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16, has returned to background levels. AR2891 is now much less active and decaying steadily, with any new enhancements now considered a very low probability in the short term.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton trace GOES.



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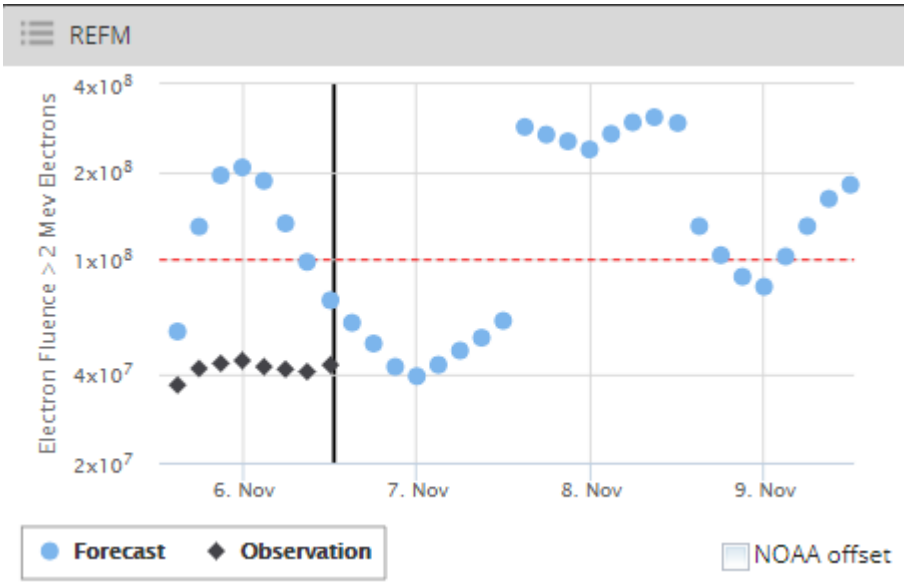
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) was at mostly moderate levels in the past 24 hours, with some brief peaks above the high threshold around the diurnal maximum, peak 1.82e3 at 05/1625UTC. Following the recent period of strong solar winds, and with speeds still elevated, a similar pattern is likely on day 1 (6th). Later on day 1 (6th) or during day 2 (7th) some connection with coronal hole 17/+ is likely. This should maintain a risk of exceeding the high threshold on diurnal peaks, perhaps with a slight rising trend through the period as the Van Allen belts recover.

Corresponding 24 hour electron fluence values are currently below the Active (1e8 integrated pfu) level, but with a flat or rising trend. An overall increasing trend is likely through the period due to anticipated coronal hole influence, The Active threshold is likely to be breached between days 2 to 4 but there is only low confidence for the timing of this. The Met Office REFM model is considered to be giving reasonable guidance in the overall trend, but is currently over-estimating fluence levels, and may be over-forecasting these levels in the forecast period.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	60	70	80
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	5	10	10

Figure 5: REFM fluence observations and forecast.



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